Challenges to Blood Draw and Test Results

Blood testing is an extremely reliable method of determining the alcohol concentration in an individual's system. Nonetheless, defendants frequently litigate their DUI cases and attempt to challenge blood test results. Taking the time to gain a familiarity with the methods and quality control standards employed by state forensic laboratories will greatly assist the practitioner to effectively address these issues. The prosecutor should work with the state forensic scientists to learn the science and better prepare for court. In general, when faced with defense experts, the prosecutor should question the factual and scientific basis for the expert opinion and challenge the interpretation of the relied upon studies. Be prepared to demonstrate that the blood test results are reliable and that science does not support the defense challenge.

CLAIM: The swab used to cleanse the skin prior to the blood draw contained alcohol and contaminated the sample.

RESPONSE:

As a preface, this claim is potentially useful only in attacking DUI alcohol cases. Alcohol will not negatively affect the blood analysis in DUI drug cases.

Two things must occur for the swab to affect the test results. First, liquid from the swab would have to enter the needle and contaminate the sample as a result of the draw sight not being allowed to completely dry. Second, the substance on the swab would have to be measured by the blood testing instrument as ethyl alcohol.

In most cases, a swab containing no alcohol will be used to cleanse the skin for a blood draw. The most common types of swabs used in DUI cases contain benzalkonium chloride (BZK) and povidone-iodine (Betadine). Neither contains alcohol. Accordingly, the first response to this attack is to be pro-active. When the swab does not contain alcohol, simply ask the person who drew the blood or the officer who observed the blood draw what type of swab was used to cleanse the skin during direct examination. Bring out that this type of swab is commonly used for blood draws in DUI cases and does not contain alcohol. This will often prevent the defense attorney from even raising the issue. If it does not, get the defense expert to

concede the swab used was not a type that contains alcohol and would not negatively affect the test results.

In rare cases, isopropyl alcohol is used to cleanse the skin or it is unknown what type of swab was used and the defense argues it was an alcohol swab. The defense argument can still be defeated. The type of alcohol used to cleanse the skin for a blood draw is isopropyl alcohol. The type of alcohol one drinks and that is measured and reported in a blood test is ethyl alcohol. Most if not all state labs use gas chromatography to determine blood alcohol concentrations. Gas chromatography is a separation science. When used in blood alcohol testing, it detects and reports isopropyl alcohol separately from ethyl alcohol. Accordingly, only ethyl alcohol is reported even if isopropyl alcohol is present. Bring this out through the testimony of the analyst.[1]

If possible, the prosecutor should elicit testimony establishing the person drawing the blood allowed the site to dry before inserting the needle. Even if ethyl alcohol had been used to clean the arm, contamination is unlikely if the alcohol evaporated prior to the draw. Finally, if vacutainer collection tubes were used, the person drawing the blood can testify that he/she removed each tube from the needle and holder before the needle was withdrawn from the arm. This phlebotomy protocol prevents any possible contamination from the skin when the needle is removed from the arm.

CLAIM: The presence of clots in the blood sample artificially increased the reported alcohol concentration.

RESPONSE:

In DUI alcohol cases, blood collection tubes with gray stoppers are commonly used because they contain both an anticoagulant and a preservative (stabilizer). These gray top tubes are specifically recommended for DUI blood draws. The anticoagulant is potassium oxalate and the preservative is sodium fluoride (NaF).

Be proactive. When applicable, elicit testimony the blood was collected in gray top tubes containing an anticoagulant. Have the person who drew the blood or the officer who observed

[1] *See* the section on contamination for more detail.

the blood draw testify that a gray top tube was used and the tube contained a white powdery substance indicating the presence of an anticoagulant. The witness can testify that after the blood draw the tubes were inverted as recommended by the manufacturer to ensure the anticoagulant mixed with the blood. The analyst can also testify that inspection before testing verified that there was no undissolved powder and no clots present. The analyst should also be able to testify that the purpose of the anticoagulant is to prevent clotting. These simple steps should provide the ammunition necessary to demonstrate clots are not an issue.

If an anticoagulant was not in the tube used to collect the blood, a whole blood sample will be clotted. While this will not affect the amount of alcohol in the blood sample it may affect the manner in which the alcohol content is reported. The lab can analyze a clotted sample by either using a tissue grinder which breaks up the clots to produce a homogenous sample or it can use the centrifuge method where the sample is spun down and only the serum layer at the top is tested. If the grinder is used, some alcohol may be lost through evaporation. Point out this would be to the defendant's benefit. If the centrifuge method is used the serum layer will produce results that report a higher alcohol concentration than that associated with whole blood. Accordingly, a conversion will need to be conducted by an expert.[2]

Micro clots

A variation of this claim is that the blood contained micro clots and these micro clots somehow make the sample non-homogeneous and artificially raise the reported alcohol concentration. It appears this idea has been extrapolated from situations using centrifuged samples where blood cells are packed at the bottom of the blood tube and the serum layer has a higher alcohol concentration than whole blood would. No peer-reviewed, published studies support the micro clot claim**.** It is speculative at best to assume microscopic clots in whole blood could artificially raise the alcohol concentration reported. Experts commonly testify a clot that is big enough to affect the test results would need to be at least the size of a pencil eraser. It is standard practice for an analyst to look for, make note of and address any clots that could negatively affect the test results.

If faced with a defense expert who testifies to the theoretic possibility of this phenomenon, ask for the citation to any published literature confirming the claim. Ask the expert

[2] *See* the section on whole blood vs. serum for conversion rates.

if he/she has seen any evidence of this in his/her own casework. Emphasize all of the measures noted above that guard against clots affecting the analysis.

CLAIM: Improper package and storage of the blood caused the development of yeast (C*andida albican)* artificially increasing the reported alcohol concentration (fermentation).

RESPONSE: Alcohol concentration does not increase during storage.

The studies generally relied on by the defense to support this attack used post-mortem blood specimens. Subsequent studies involving blood samples taken from live individuals indicate the alcohol concentration does not increase during storage after the blood draw even if the blood is not refrigerated and does not contain a preservative.[3] The lack of refrigeration and preservative will likely result in the loss of alcohol concentration in the blood.[4] This would be to the defendant's benefit. If the sample contains sodium fluoride and is refrigerated, the general consensus is that no fermentation will occur. Heat should not affect the sodium fluoride. It is a highly stable inorganic salt with a melting temperature above 300 degrees F.

Defense experts will often rely on the Amick & Habben study to assert fermentation can occur in the blood of live subjects.[5] This study can be easily distinguished from the average blood analysis. During the study, participants intentionally added yeast to blood samples, something that does not occur in DUI investigations. The inoculated samples that were not refrigerated and did not contain sodium fluoride produced small amounts of ethyl alcohol. However, the blood samples containing sodium fluoride did not produce ethyl alcohol even with heavy seeding of the yeast.

While it is *theoretically possible* for yeast in blood samples to convert glucose into ethanol, it is not a realistic concern. In order for this type of fermentation to occur several things need to take place. The blood would have to be collected in a tube that did not contain sodium fluoride because sodium fluoride will starve yeast. Glucose would have to be present in the blood and the blood would need to be stored at greater than room temperatures. It is unlikely

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[3] Glover, *The Effect of Heat on Blood Samples Containing Alcohol,* 2002; Winek & Louette, *Effect of Short-term Storage Conditions on Alcohol Concentrations in Blood from Living Human Subjects,* 29 Clinical Chemistry 11 (1983).

[4] Brown, Neylan, Reynolds and Smalldon, *The Stability of Ethanol in Stored Blood, Part I, 66 Analytica Chimica Acta 271 (1973).*

[5] Amick & Habben, *Inhibition of Ethanol Production by Saccharomyces cerevisiae in Human Blood by Sodium Fluoride*, J Forensic Sci 690 – 692 (1997).

that each of these conditions would be present. Even if it were, yeast would also have to be present in the defendant's blood. An individual with *Candida albicans* in his/her blood would be very sick. Affected individuals are usually hospitalized and without rapid treatment may die.

CLAIM: The State has not demonstrated that the gray top blood tubes used to draw the blood contained the proper chemicals to ensure a valid analysis.

RESPONSE:

It is standard practice for the state's expert to inspect the blood tubes prior to analysis and report any unusual appearance or odor. If the analyst reports that the sample was not clotted, it can be assumed that the quantity of anticoagulant was sufficient. The manufactures of the blood kits introduce the anticoagulants and preservatives as a mix. Accordingly, the fact that the blood did not clot indicates that both the anticoagulant and preservative were present. As noted in the storage issues section, the lack of a preservative (stabilizer) should only result in the faster loss of blood alcohol concentration which would benefit the defendant. It will not lead to a situation where the results report an artificially high alcohol concentration. Admitting the manufacturer's certification for the type of tubes that were used may also assist with defending against this claim. Elicit testimony from the analyst regarding the lab's procedures for inspecting and analyzing the tubes and have the person who drew the blood, or officer who observed it, testify that the tubes contained a white powdery substance.

CLAIM: Serum and plasma have higher alcohol contents than whole blood. Because BAC is measured in terms of whole blood, the serum and plasma results are misleading.

RESPONSE: Because they contain more water than whole blood, serum and plasma samples will each have a higher alcohol content than whole blood. Serum and plasma can be expected to have equivalent alcohol concentrations.

The ratio between the alcohol concentration of serum and that of whole blood depends on the water content of each sample and will vary among individuals. Serum to whole blood

alcohol ratios appear to range from .91 to 1.31 with the extreme ranges being rare. The higher the ratio, the lower the blood alcohol reading will be after the conversion. Generally, expert testimony will be necessary to make the conversion. Most experts agree that if one has a serum sample, a reliable estimate of the whole blood alcohol content can be obtained by dividing the serum alcohol concentration by 1.14 to 1.16. Some state forensic scientists divide by 1.20 because with this calculation it is extremely unlikely that the defendant will be prejudiced.

Blood alcohol testing in hospitals is often performed on serum or plasma. Accordingly, if the blood analysis was conducted at a hospital it would be prudent to contact the hospital to determine if the test was conducted on whole blood or serum/plasma. The reported results may specify this. If serum/plasma was tested, a conversion will need to be conducted. The expert should be contacted to determine the conversion ratio he or she uses prior to court. This information should be disclosed to the defense.

CLAIM: The blood testing instrument measured and reported something other than ethyl alcohol and this artificially increased the reported BAC.

RESPONSE:

Gas chromatography is the method used by most, if not all, state labs to test alcohol in blood. It is a universally accepted separation science. When using this method, the instrument separates the sample in a column and measures the amount of the substances it tests for as they come out of the column at different, specific times. Because it separates volatile substances such as ethyl alcohol and isopropyl alcohol before analysis, gas chromatography is very specific. It does not allow interference by other substances.

Method validation has demonstrated gas chromatography's ability to differentiate other volatile substances from ethyl alcohol. This validation has been conducted extensively by the scientific community. The individual lab that conducted the analysis should also have conducted method validation and should be able to provide supporting testimony in court.

To ensure accuracy when testing blood for alcohol, state labs generally conduct duplicate tests on DUI blood samples. Duplicate testing analyzes a subject's blood twice using separate

portions of the sample. Dual columns are also often used resulting in testing each portion of a duplicate test twice. Dual column gas chromatography is considered the "gold standard" in the scientific community for analyzing blood alcohol. If it is used, virtually any chance of co-elution of the sample will be eliminated because the nature of the material in the columns will cause different compounds to exit the column or elute at different times. In order for a substance other than ethyl alcohol to contaminate a blood alcohol result, another volatile compound must be present at a high enough concentration to be registered by the gas chromatograph. Few substances fit in this category. In addition, the substance would have to have the same retention time as ethyl alcohol on both columns of the chromatograph.

CLAIM: The tubes used to collect the blood were expired, so the results cannot be trusted.

RESPONSE:

The blood collection tubes that are used with the vacutainer system come with an expiration date. This is because as the tubes age, the vacuum in the vacutainer loses its effectiveness and will not pull blood into the tube as efficiently as new tubes. When the tubes do get old, vacuum loss is the only issue. The anticoagulants and preservatives that are contained in most tubes used for DUI blood draws do not expire or go bad with age. Both are inorganic salts that are highly stable. Because vacuum loss is the only issue, if the tube efficiently drew a full amount of blood this is a good indicator that sufficient vacuum was present.

If the tube does not fill completely due to the vacuum loss, there could be an excessive amount of air in the tube. This could result in the loss of alcohol in the sample and a lower reported alcohol concentration which of course would not prejudice the defendant. Another risk is that an expired tube will not draw enough blood for analysis. This is especially true in DUI drug cases because more blood is required to test for drugs than alcohol.

If the vacuum loss somehow affected the tube's seal, the most likely result would be the loss of alcohol concentration or other volatile substances such as inhalants.

CLAIM: Arterial blood is a much better indicator of actual BAC levels when compared to venous blood.

Defense experts will claim that because arterial blood is the blood flowing to your brain, it is the "impairing" blood. Some will also testify that the venous blood could be as much as .05 higher than the arterial blood. Because the blood drawn was venous blood, they assert the results do not reflect impairing blood or .05 should be subtracted from the State's blood test results.

RESPONSE:

As a preliminary matter, this entire line of testimony should be objected to as irrelevant. Generally, the defense uses this testimony to attack the blood test results in an attempt to try to get the reading below the State's *per se* limit. Most *per se* statutes prohibit a person from driving or physically controlling a vehicle if the person has "an alcohol concentration" of .08 or greater. Alcohol concentration is defined differently in different states. None of the definitions appear to contain even the suggestion that the blood must be either arterial blood or venous blood. The statutes, therefore, permit a blood alcohol reading to establish the element of alcohol concentration/content without regard to the question of whether the blood is arterial blood or venous blood. Basically, because it is illegal to drive or physically control a vehicle if the blood alcohol reading exceeds the *per se* limit, it is irrelevant under the *per se* statutes whether the blood is arterial or venous. It is also irrelevant whether the reading from one might slightly differ from the other. Blood is blood and it is illegal to drive if anywhere in one's body the blood has an alcohol concentration above the *per se* limit. The state's toxicologist will establish that the result admitted at trial is an accurate measurement of the blood sample and is, therefore, an accurate measurement of the defendant's alcohol concentration at the time the blood was drawn.

Challenge the scientific support for this defense claim. A study on the topic by Jones, Norberg and Hahn concluded that during the absorptive phase, arterial blood has a higher alcohol concentration averaging a maximum of .01, which rapidly diminishes to almost nothing once absorption stops.[6] Once in the post absorptive phase, venous blood and arterial blood are almost

[6] Jones, Norberg, Hahn, *Concentration-Time Profiles of Ethanol in Arterial and Venous Blood and End-Expired Breath During and After Intravenous Infusion*, J Forensic Sci 1088 – 1094 (1990).

exactly the same. The study found that the average difference between the two was about .001 - .002. (in terms of actual BAC level in gr/100 ml blood), not the .05 some defense experts put forward. Moreover, the study found that arterial-venous differences are at their most pronounced in body tissues with low blood flow to mass ratios such as skeletal muscle. In body tissues that are highly vascularized with high blood flow to mass ratios such as the brain and kidneys, the arterial-venous blood difference is negligible. Consequently, arterial-venous differences are negligible in the brain.

CLAIM: The gray top tubes used to collect the blood samples were not FDA approved. Therefore, the jury and/or judge should not trust the results.

RESPONSE:

The manufactures of the blood kits and tubes generally get FDA approval for their products. In some instances, the entire kit may be FDA approved. Implicit in this is approval is the fact that the contents of the kits, including the tubes, are FDA approved for collecting blood. Other companies have the tubes individually approved by the FDA. If asked, most companies will provide documentation of FDA approval. (Beth has many of these)